Programme outcome for BSc Programme

Three-year B.Sc. Programme

The Three-year B.Sc Programme at Dempo Charities Trust's Dhempe College of Arts and Science offers courses at First, Second and Third year level in the subjects of Physics, Chemistry, Mathematics, Zoology, Geology, Botany, Computer Science and Biotechnology. All of these subjects are designed with a specific aim of introducing students to various laboratory methods thereby exposing them to several laboratory techniques in handling of state of the art equipment, critical thinking and being independent as well as team learning. They develop laboratory skills throughout the curriculum via hands-on experiences with diverse experimental techniques and tools. They learn several approaches to data analysis and become confident in using computational methods to analyze and solve various problems. Although the student's long term goals are quite varied, these courses help in drawing many to careers that demand scientific and technical knowhow and strong logical reasoning abilities. The following is a specification of the key Programme Outcomes (knowledge, skills, values and attitude) that highlight important areas in which the students are expected to gain proficiency at the end of the tenure of their undergraduate program.

(1) **PO-1: Knowledge:** Learners are encouraged to apply the knowledge of mathematics and science fundamentals to various solutions of complex problems. As such, knowledge of the subject is the sole objective of any student learner. A student is exposed to a wide range of topics in various subjects and is given intensive training in each of the courses that have laboratory related work. The learner is encouraged to use various mathematical methods (analytical and numerical) and experimental methods as an application to the acquired concepts and principles that help in studying various branches of sciences. At the end of the program, students are able to gain thorough knowledge in key areas in the subjects offered.

(2) **PO-2: Problem Analyses:** Well equipped with an understanding of the analytical methods involved, they are in a position to interpret and analyze results so obtained from experiments and draw suitable conclusions against their supported data acquired. At the end of the program, students will be able to identify, formulate and analyze scientific problems and reach concrete solutions using various principles of mathematics and sciences.

(3) **PO-3: Designing Solutions:** Having acquired knowledge of subjects, students are trained to think out of the box, design and conduct an experiment or a series of

experiments that demonstrate their understanding of the methods and processes involved. For example, as a part of the project of the final year, students in the subject of Physics are encouraged to calculate the overall power consumption of the institution and think of ways and means of minimizing this consumption through alternate sources of energy. This in turn helps in the learner; develop a holistic approach from real time solutions. As such, at the end of the program, learners will be able to design solutions for complex problems and design a process/ processes that can meet specific needs. (Attainment of this is through projects at the final year level).

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(4) **PO-4: Modern tool usage:** As an outcome of PO-1, PO-2 and PO-3, learners are trained to create, select, and apply appropriate techniques, resources and IT tools in the analysis and synthesis of data within limitations. (Outcome of final year project).

(5) **PO-5: Communication Development:** The medium of instruction being English, proficiency in the subject through English is one of the primary objectives of the science program. In order to improve the writing and oral skills of learners, the program caters to ensuring that learners become effective, clear communicators in written and oral work and are capable of explaining complex issues in accessible terms. With English language being the common mode of communication worldwide, all learners under the programme are encouraged to participate in courses designed to equip students with English-language proficiency through Grammar, Written and Spoken English to enable a holistic enhancement of communication. Through a selection of courses such as ability enhancement courses, learners are also trained to communicate efficiently in the languages of Konkani, Hindi and Marathi. As such, at the end of the program, learners will be capable of oral and written communication, and will prove that they can think critically and work independently. Learners will be able to communicate effectively on scientific issues with the scientific community and society at large in writing effective reports and designing documentation, make effective presentations and give and receive instructions.

(6) **PO-6: Employability:** With our learners long-term professional pursuits being quite varied, many are drawn to careers that require scientific skills or technical expertise or strong quantitative reasoning abilities. Keeping this in mind, the institution apprises students of various employment opportunities that are available in areas of their choice through the Placement cell. To equip these learners with knowledge other than that of the subject such as skills required helping them qualify for jobs, all the science subjects offer skill enhancement courses and value added courses so that learners have a better edge over their counterparts. For example, the subject of Physics offers a value added course titled" Certificate Course in Electrical and Electronic Instrumentation" that offers learners with additional skills of handling scientific instruments, performing calibrations etc. As such, at the end of the programme

students will be able to increase their employability through subject knowledge and additional skills.

(7) **PO-7: Ethics:** While it is necessary to instil the spirit of competitiveness among students in a world of increasing competition, it is equally vital to develop a strong sense of ethics among learners that will help them develop some positive attitudes and values. This includes appreciation of the various principles and theories that evolved in science, the impact that science has on social, economical and environmental issues. One of the main objectives of any academic exercise, therefore, should be to produce well-groomed individuals who understand the significance of ethical values and abide by them even in the most pressing circumstances. In this programme, this process is enabled through courses and facilitators who integrate the teaching of ethics in everyday pedagogy. As such, at the end of this programme students will be able to develop, internalise and exercise ethics in their professional as well as personal practices.

(8) **PO-8: Environment and Sustainability:** 'Environmental sustainability' has become the watchword of the 21st century. An increased engagement with environment-related concerns is appearing tangibly on global fronts; academics cannot and *should not* remain quarantined from this massive development. Through classroom-discussions and research projects, this programme facilitates active dialogues with factors which influence human-ecology interactions. As such**,** at the end of this programme students will be able to identify and analyze socio-political, cultural and economic problems which act as deterrents to environmental sustainability and provide creative solutions towards the same.

(9) **PO-9: Soft-Skill Development:** Apart from the attainment of knowledge and hands-on skills in practical applicability of the subject, learners need to be equipped with soft-skills and values which will help them function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary groups. These soft-skills include leadership, teamwork, project-management, positive outlook, innovative approaches and effective articulation. Several soft skill programs are organized for learners through various agencies that tie up with the state government. As such, at the end of this programme, students will be able to hone the soft-skills required in positively enhancing their academic, professional and personal pursuits towards self and societal advancement.

(10) PO-10: Science and Society: As an outcome of PO-1, PO-2 and PO-3, learners are encouraged to apply logical reasoning based on the knowledge, skills, designing solutions to assess societal, health, safety issues and the responsibilities that go along with the scientific practice. As an extension activity to society, learners are

encouraged to take up specific projects such as impact of salinity on fresh water wells in an adopted village, and provide effective solutions.

(11) **PO-11: Life-long learning:** With the pursuit of knowledge for either personal or professional reasons, learners are also encouraged to volunteer and be self-motivated that not only enhances society values, active participation and personality development, but also enhances self-sustainability, competiveness and employability. As such, learners will be able to recognize the need for, and have the preparation and ability to engage in independent and life-long learning in every broad context of technological changes.

Physics

PSO1: Students will be able to acquire core knowledge in Physics in the key areas, develop written & oral communication skills in communicating physics-related topics.

PSO2: Design & conduct an experiment, demonstrate their understanding of the scientific methods & processes.

PSO3: Develop proficiency in acquiring data using a variety of instruments, analyze & interpret the data, learn applications of numerical techniques

PSO4: Realize & develop an understanding of the impact of Physics & science on society.

Semester-I

Course: Mathematical Methods and mechanics and Electrical circuit theory (PYC101).

Course outcome: ***At the end of the course, students will be able to:***

Section-I (Mathematical methods & Mechanics)

1. To acquire knowledge and apply it to various physical problems.
2. To apply and develop the problem solving ability in specific areas, apply vectors.
3. To gain knowledge to learn motion of bodies.
4. To acquire basic knowledge of mechanics, properties of matter and gravitation, know how to apply the conservation of rotational motion.
5. Understand the concept of Linear & rigid motion, system of particles.
6. Solve problems related to the above concepts.

Section-II (Electrical Circuit theory)

Course outcome: ***At the end of the course, students will be able to:***

1. Use the concept of current & voltage source in circuit analysis, apply theorems to relevant circuits.
2. Understand the working of transformer & effect of loading.

Course: GE-Basic Physics (PYG101)

Semester-I

Course outcome: ***At the end of the course, students will be able to:***

1. Understand measurement of physical quantities, standards and units.
2. Understand properties of matter and their applications to phenomena of life sciences.
3. Apply the principles of acoustics to everyday phenomena.
4. Classify electrical, mechanical and optical transducers and their applications in chemical and biological instruments.

Semester-II

Course: Heat & Thermodynamics and Properties of Matter & Acoustics.

Section-I (Heat & Thermodynamics)

Course outcome: ***At the end of the course, students will be able to:***

1. To understand the difference between solids, liquids & gases.
2. Understand the principle of calorimetry.
3. Understand the basic principle and define the laws of Thermodynamics.
4. Understand the concept of Entropy.

Section-II (Properties of Matter & Acoustics)

Course outcome: ***At the end of the course, students will be able to:***

1. Study the elastic behaviour and working of Torsional pendulum.
2. Understand the behaviour of bending beams.
3. Analyze waves and oscillations.
4. Study the basic properties of ultrasonics by different methods.

Course: GE-Optics & Instrumentation (PYG-102)

Course outcome: ***At the end of the semester, students will be able to:***

1. Understand the image formation by lenses, their defects and draw cardinal points for a lens system.
2. Apply the principles of light to various phenomena such as interference, diffraction.
3. Analyze X-ray diffraction data for crystal structure determination.
4. Apply the basic principles of basic medical imaging physics to NMR, MRI.

Semester-III

Course: Mechanics-II

Course outcome: ***At the end of the course, students will be able to:***

1. To gain knowledge to learn motion of bodies.
2. To acquire basic knowledge of mechanics, properties of matter and gravitation, know how to apply the conservation of rotational motion.
3. Understand the concept of Linear & rigid motion, system of particles.
4. Solve problems related to the above concepts.

Course: Electronics.

Course outcome: ***At the end of the course, students will be able to:***

1. To gain knowledge of basic devices such as diodes, transistors, thermister etc.
2. Apply them to various circuits such as rectifiers, amplifiers.
3. Understand the effect of temperature on performance of devices such as transistors.
4. Device methods for effective performance of these devices under various conditions.
5. Apply them to solve various circuit problems.

Semester-IV

Course: Heat & Thermodynamics.

Course outcome: ***At the end of the course, students will be able to:***

1. To understand the difference between solids, liquids & gases.
2. Understand the principle of calorimetry.
3. Understand the basic principle and define the laws of Thermodynamics.
4. Understand the concept of Entropy.

Course: Modern Physics.

Course outcome: ***At the end of the course, students will be able to:***

1. Determine the e/m for a charged particle.
2. Review the concept of atomic model and apply it to determine the energy levels for a given gas.
3. Understand typical crystal structures and determine their structure using X-ray diffraction.
4. Define lasers, classify the different types of lasers and apply them to optic fibres and holography.

Semester-V

Course: Electronics.

Course outcome: At the end of the course, students will be able to:

1. Understand the concept of transistor.
2. Apply the concept of transistor as a switch in switching applications such as multivibrator circuits.
3. Convert Binary to decimal numbers and vice-versa.
4. Understand the basic function of logic gates and their applications.

Course: Wave mechanics.

Course outcome: ***At the end of the course, students will be able to:***

1. Review Bohr's postulates and apply them to the hydrogen atom.
2. Demonstrate the wave nature of particles,
3. Learn the concept of wave function and apply them to Schrödinger's equations.

Course: Nuclear Physics.

Course outcome: ***At the end of the course, students will be able to:***

1. Study of the structure of nucleus.
2. Know the formation of nucleus and their binding energies.
3. Understand the concept of nuclear reactions and nuclear fission.
4. Analyze the energy released by the nucleus in a process of fusion.

Course: Electromagnetic theory-I

Course outcome: ***At the end of the course, students will be able to:***

1. Have an understanding of Maxwell's equations and apply them to EM problems.
2. Analyze moving charges in magnetic fields.

3. Master techniques to solve electrostatic problems.
4. Understand boundary conditions on field vectors and apply them to solve problems.

Semester-VI

Course: Solid state Instrumentation & Devices.

Course outcome: ***At the end of the course, students will be able to:***

1. Classify industrial devices based on their properties and working mechanism.
2. Identify two terminal devices and their working.
3. Apply these devices to basic instrumentation circuits.
4. Construct basic Analog voltmeter and ammeter.

Course: Atomic & Molecular Physics.

Course outcome: ***At the end of the course, students will be able to:***

1. Describe atomic spectra of one and two valence electron atoms.
2. Explain the change in behaviour of atoms in electric and magnetic fields.
3. Explain Rotational, Vibrational, electronic and Raman spectra of molecules.
4. Describe electron spin and nuclear magnetic resonance.

Course: Thermodynamics & statistical Mechanics.

Course outcome: ***At the end of the course, students will be able to:***

1. To understand how statistics of the microscopic world can be used to explain thermal features of the macroscopic world.
2. Be able to use thermal and statistical principles in a wide range of applications.
3. Learn a variety of mathematical techniques.

Course: Electromagnetic theory –II

Course outcome: ***At the end of the course, students will be able to:***

1. Understand Biot Savart's law, Ampere's law and apply them to various problems.
2. Describe and analyze distributed systems such as transmission lines and fields.
3. State several laws and principles of electric, magnetic, and electromagnetic fields.
4. Use vector calculus and other mathematics to describe electromagnetic phenomena.

5. Solve problems in electrostatic, magnetostatic, and electromagnetic fields.
6. Describe the principles of operation of several electrical, magnetic, and electromagnetic devices

Mathematics

PSO1: Students will be able to acquire core knowledge in Physics in the key areas, develop written & oral communication skills in communicating physics-related topics.

PSO2: Design & conduct an experiment, demonstrate their understanding of the scientific methods & processes.

PSO3: Develop proficiency in acquiring data using a variety of instruments, analyze & interpret the data, learn applications of numerical techniques

PSO4: Realize & develop an understanding of the impact of Physics & science on society.

Course: Calculus and Numerical Methods
Course outcome: ***At the end of the course, students will be able to:***

1. To develop an analytical mind in the beginners of BSc Maths students.

Course: **Numerical Methods**
Course outcome**: *At the end of the course, students will be able to*:**

1. Apply numerical methods to obtain approximate solutions of mathematical problems.
2. Analyze and evaluate accuracy of common numerical methods.
3. Apply numerical methods to obtain approximate solutions of mathematical problems

Course: **Calculus of two variables**
Course outcome: ***At the end of the course, students will be able to***:

1. Differentiate functions of two variables.
2. Compute line integrals

Course: **Analysis I**
Course outcome: ***At the end of the course, students will be able to:***

1. To prove Simple mathematical theorems on simple basic mathematical ideas such as sequences, series of real numbers and functions.

Course: **Algebra**
Course outcome: ***At the end of the course, students will be able to***:

1. Perform standard group computations and permutations on a finite set.
2. Give standard examples of Groups, Rings and Fields.
3. Apply Lagrange's theorem to study subgroups of a finite group.
4. Understand the notion of homomorphism and isomorphism of groups and rings

Course: Analysis II
Course outcome: ***At the end of the course, students will be able to***:

1. A student should to able to prove Simple mathematical theorems on simple basic mathematical concepts such as Riemann integration, improper integrals and Beta Gamma functions.

Course: Vector Calculus
Course outcome: ***At the end of the course, students will be able to***:

1. Understand vectors to perform geometrical calculations in three dimensions.
2. Calculate and interpret derivatives in up to three dimensions.
3. Integrate functions of several variables over curves and surfaces.
4. Use greens theorem, Gauss Divergence Theorem and Stokes theorem to compute various integrals such as Line, surface and Volume integrals.

Course: Number Theory
Course outcome: ***At the end of the course, students will be able to:***

1. By the end of the course, the students should be able to write rigorous mathematical proofs.

Course: Operations Research
Course outcome: ***At the end of the course, students will be able to:***

1. Students should be able to write any economic model in mathematical forms to optimize it under given circumstances (i.e. with limited resource available.)

Course: Matrices and Linear Algebra
Course outcome: ***At the end of the course, students will be able to***:

1. Solve system of linear equations using Gaussian elimination and matrix inversion.
2. Carry out matrix operations including inverse and determinants.
3. Demonstrate concepts of vector spaces, subspaces, span and basis.
4. Determine Eigen values and Eigen vectors and solve problems.
5. Apply principles of matrix algebra to linear transformations.
6. Demonstrate understanding of inner product spaces and norms.

Course: Matrix algebra
Course outcome: ***At the end of the course, students will be able to:***

1. Solve system of linear equations using Gaussian elimination and matrix inversion.
2. Carry out matrix operations including inverse and determinants.
3. Demonstrate concepts of vector spaces, subspaces, span and basis.

Course: Differential equations
Course outcome: ***At the end of the course, students will be able to***:

1. Students should be able to solve any differential equation in applied science.

Course: Linear Algebra
Course outcome: ***At the end of the course, students will be able to***:

1. Demonstrate concepts of vector spaces, subspaces, span and basis.
2. Determine Eigen values and Eigen vectors and solve problems.
3. Apply principles of matrix algebra to linear transformations.
4. Demonstrate understanding of inner product spaces and norms.

Course: Metric spaces
Course outcome: ***At the end of the course, students will be able to:***

1. Understand Euclidean distance function and its properties.
2. Explain geometric meaning of the metric space properties.
3. Define convergence of a sequence in a metric space.
4. Understand continuity between two metric spaces.

Course: Complex Analysis
Course outcome: ***At the end of the course, students will be able to:***

1. Perform basic operations on complex numbers.
2. Geometric interpretation of complex numbers.
3. Understand analytical functions, contour integrals and series of complex numbers.

Course: Analysis II
Course outcome: ***At the end of the course, students will be able to:***

1. To write half range and full range Fourier series.
2. Understand special functions such as logarithmic, exponential and trigonometric functions.

Course: Differential Equations II
Course outcome: ***At the end of the course, students will be able to:***

1. Solve differential equations using power series method.
2. Solve differential equations using Laplace transforms.

3. Solve differential equations using numerical methods like Runga kutta methods and Milne's Method.

Course: Operations Research II

Course outcome: ***At the end of the course, students will be able to:***

1. To solve decision making problems.
2. Solve problems on smooth functioning of an enterprise using inventory models.

Zoology

PSO1: Students will acquire knowledge on basic, important concepts in the field of Zoology such as Physiology, Taxonomy, Evolution, Genetics, Wildlife Biology, Developmental Biology and Comparative Anatomy and can be applied to fields such as Animal Biotechnology.

PSO2: Students will learn how to identify organisms, understand animal body systems, understand population dynamics in the environment as well as apply these concepts when conducting field surveys.

PSO3: Students will also gain a sense of responsibility, appreciation and conservation with regards to nature and environment

Course: ZOC 01: Non-Chordate Zoology and Cell Biology
Course outcome: ***At the end of the course, students will be able to:***

1. Gain knowledge on the different non chordate taxa and their characteristics.
2. Distinguish between organisms in the laboratory as well as in the environment.
3. Gain knowledge on the structure and functioning of cells.
4. Understand how abnormalities within cells can lead to a cancerous state.

Course: ZOC 02: Diversity of Chordates and Genetics
Course outcome***: At the end of the course, students will be able to:***

1. Gain knowledge on the different chordate taxa and their characteristics.
2. Understand the adaptations acquired by different groups.
3. Understand the concepts in Classical genetics and Modern Genetics.
4. Gain knowledge on the molecular structure and function of hereditary material (DNA).
5. Apply the understanding of DNA to processes such as mutation, inheritance etc.

Course: ZOC 03: Comparative Vertebrate Anatomy
Course outcome: ***At the end of the course, students will be able to:***

1. Examine and correctly identify the systems of various vertebrate groups.
2. Compare differences in the systems of various vertebrate groups.
3. Understand how organisms utilize specialized structures to their advantage in nature.

Course: ZOC 04: Animal Physiology and Biochemistry
Course outcome: ***At the end of the course, students will be able to:***

1. Gain knowledge on the physiological processes of different body systems.
2. Understand basic concepts in biochemistry.
3. Acquire knowledge on the important macromolecules such as lipids, proteins and carbohydrates.

Course: ZP 08: Human Physiology & Biochemistry

Course outcome: ***At the end of the course, students will be able to:***

1. Understand the working mechanisms and biomolecules associated within the body.
2. Gain knowledge on the mechanics and kinetics of enzymes.
3. Apply this knowledge and infer the data, medical reports in pathology laboratories and diagnostic laboratories.

Course: ZP 09: Comparative Anatomy of vertebrates.

Course outcome: ***At the end of the semester, students will be able to:***

1. Examine and correctly identify the systems of various vertebrate groups.
2. Understand the evolution of various structures across different vertebrate groups.
3. Understand the function of specialized organs in different vertebrate groups.

Course: ZP 10 Fundamentals of Animal Biotechnology.

Course outcome: ***At the end of the course, students will be able to:***

1. Identify colony forming microbes and to learn how to culture them.
2. To culture a cell line and perform carious experiments with them.
3. Perform or carry out different techniques in a pathological laboratory, pharmaceutical laboratory or research laboratory.

Course: ZP 11 Applied Genetics and Evolution.

Course outcome: ***At the end of the course, students will be able to:***

1. Gain knowledge on various processes that involve DNA, RNA and proteins in living organisms.
2. To analyze and diagnose various genetic diseases and defects.
3. To interpret and analyze data from research papers and to be able to apply and implement these concepts to research based work carried out in the field or laboratory.
4. To gain knowledge on various theories of evolution and the evidences and proofs that supports these theories.

Course: ZP12 Developmental Biology.

Course outcome: ***At the end of the course, students will be able to:***

1. To know the importance of developmental biology and processes such as embryogenesis and blastogenesis.
2. To gain knowledge on the various processes that occurs during fertilization and embryonic development in various animal groups.
3. To acquire knowledge on the concept of regeneration as well as mechanism of ageing.

Course: ZP13 Endocrinology.

Course outcome: ***At the end of the course, students will be able to:***

1. To define endocrinology and understand hormones and their mode of action and regulation.

2. To gain knowledge on the various organs and their secretions.
3. To understand the diseases associated with hyper and hypo secretion of hormones.

Course: ZP14 Environmental Biology and Toxicology.
Course outcome: ***At the end of the course, students will be able to:***

1. To know the resources present in India.
2. To gain knowledge on various concepts in population dynamics.
3. To gain insight on the wildlife of India and their conservation status.
4. To understand toxicology and mechanisms associated with toxicity.

Course: ZP15 Animal Biotechnology applications.
Course outcome: ***At the end of the course, students will be able to:***

1. Gain knowledge on animal cell culture, understand the intricacies involved in culturing cells.
2. Apply this knowledge for large scale production of products.
3. Understand gene transfer for the production of transgenic animals.
4. Apply this knowledge in fisheries, farming and sericulture.

Course: ZOSE 1 Aquarium Fish-keeping.
Course outcome: ***At the end of the course, students will be able to:***

1. Gain insight on aquarium fish keeping as a potential cottage industry.
2. Know the variety of aquarium fish and the skill involved in rearing them.
3. Understand the diseases associated with aquarium fish and how to treat them.

Course: ZOSE2 Wildlife and Eco-tourism.
Course outcome: ***At the end of the course, students will be able to:***

1. Gain insight on the wildlife of India and their importance.
2. Understand the conservation status of the wildlife and ways to protect them.
3. Promote eco-tourism as a way of conservation of wildlife.

Computer Science

PSO1: Understand concepts of computer organisation, operating systems and computer networks.

PSO2: design data structures and algorithms for real life problems.

PSO3: develop data storage and retrieval techniques, build computer based application.

Course: Programming Fundamentals Using C
Course outcome: ***At the end of the course, students will be able to***:

1. List steps involved in problem solving,
2. Describe basic problem solving strategies,
3. Determine the best strategy for solving basic mathematical problems,
4. Design flowchart for basic mathematical problems, and model a flowchart into a C program.

Course: Data structures.
Course outcome: ***At the end of the course, students will be able to***:

1. Define data structures,
2. Explain the applications of each data structure,
3. Apply data structures for real life problems,
4. Analyze real life problems for data and functionality, compare the efficiencies of different ways of solving problems,
5. Design recursive functions for special real life problems, and
6. Derive data structures and functions for real life problems using C programming.

Course: IT Fundamentals (GE 1) (B.Sc.)
Course outcome: At the end of the course, students will be able to:

1. Identify and appreciate the use of IT in daily life

Course: Computer Fundamentals and Emerging Technologies (GE 1) (BA)
Course outcome: ***at the end of the course, students will be able to:***

1. Recall types of computers and their usage.
2. Remember different emerging technologies and be able to use Internet facilities.
3. Create blogs, collaborate on wikis, and
4. Create online data forms.

Course: Multimedia and web design (GE 2) (B.Sc.)
Course outcome: ***AT the end of the course, students will be able to***:

1. Identify and appreciate the use of IT in daily life.

Course: Cyber Space and Cyber Security (GE 2) (B.A.)
Course outcome: ***At the end of the semester, students will be able to:***

1. List cyber laws,
2. Describe computer networks, threats to cyber security,
3. Illustrate uses of Ecommerce and security measures for cyber safety

Course: Database Management Systems
Course outcome: ***At the end of the course, students will be able to***:

1. Explain database concepts, technology and practice,
2. Formulate SQL statements and queries using SQL programming and
3. Explain the use of concurrency and transactions in database.

Course: Computer organization and operating systems
Course outcome**: *At the end of the course, students will be able to:***

1. Explain Computer Organization and Operating Systems concepts and various OS technologies in use,
2. Explain the various internal processes that occur within a given Operating System,
3. Explain the use of concurrency and transactions in Operating Systems,
4. Discuss the various techniques used in managing memory of a computer,
5. Explain I/O management and security management in Operating Systems.

Course: Object Oriented Programming
Course outcome: ***At the end of the course, students will be able to:***

1. use object oriented concept while programming which include following: Define data and objects; understand need to use Object Oriented concepts in programming, understand the problems with procedure oriented programming.
2. define following

- Encapsulation
- Data Abstraction
- Data Hiding
- Abstract data types

3. Recall and use data types and data structure statements while writing programs, analyze which data structure will be best to provide solution for appropriate problem,
4. test the write code to get correct output and optimized code, define syntax Abstract data types with a class, objects, members, controlling access to members, packages, Interfaces, initializing class objects using constructors, overloaded constructors, finalizers,
5. Set and Get methods, friendly access(package access) composition-objects as instance variables of other classes
6. To write the program with Abstract data types with a class, object, members
7. To define Collections, Threading, Serialization, Generic programming.
8. To use Collections, Threading, Serialization, Generic programming

Course: Data Base Management Systems – I

Course outcome: ***At the end of the course, students will be able to:***

1. Explain database concepts, technology and practice,
2. Formulate SQL statements and queries using SQL programming.

Course: Client side web development

Course outcome: ***At the end of the course, students will be able to:***

1. Develop a high degree of competence as a web developer by learning principles and techniques of client-side programming with HTML, CSS and JavaScript and securities e-existence and report the cybercrimes if any.

Course: Data Base Management Systems – II

Course outcome: ***At the end of the semester, students will be able to:***

1. Learn basic design and security of database.

Course: Introduction to Cyber security and cyber law

Course outcome: ***At the end of the semester, students will be able to:***

1. Explain the concept and usage of Operating Systems, their directory structures, software installation etc,
2. Describe the basics of computer networks, state the various cyber-crimes taking place in the cyber world,
3. Explain the cyber laws that have been framed in order curb the related crimes,
4. Explain the concept of cyber forensics and ways to recover lost data that is lost either due to some unintentional or intentional neglect.

Course: Information Systems & IT Entrepreneurship

Course outcome: ***At the end of the semester, students will be able to:***

1. Explain various information systems in use in the market,
2. Explain the working of e-commerce in our day-to-day lives,
3. Generate new ideas with regards to business start-ups with the help of IT, discuss the workflow of Enterprise Resource Planning packages and
4. Explain the current and future trends in computing.

Course: Computer Networks

Course outcome: ***At the end of the semester, students will be able to***:

1. Define various layers in Network,
2. Draw the diagram in Networking,
3. Classify the different layers in TCP & OSI model,
4. Explain and classify the various functions in each of the layer, conclude the functions of each network layer.
5. Define the use of various devices in the network layer

Course: Android Development

Course outcome: ***At the end of the course, students will be able to:***

1. Remember components of an app, understand procedure for app development and use them to create new apps.

Course: Human Computer Interface

Course outcome: ***At the end of the course, students will be able to:***

1. List the principles of good interface design, understand the importance of interactive systems,
2. Describe the layers of user interface, determine the best strategy for designing effective user interfaces,
3. Design prototypes for user interfaces,
4. Evaluate the interface designs based on Neilsons heuristics and create effective user interfaces.

Course: Agile Software Development

Course outcome: ***At the end of the semester, students will be able to:***

1. Understand the various stages of software development such as analysis, designing, coding, testing, documenting.

Course: Network Security

Course outcome: ***At the end of the course, students will be able to:***

1. Illustrate basic encryption techniques, explain security principles, asymmetric ciphers and describe digital certificates and digital signatures.

Course: Multimedia Techniques

Course outcome: ***At the end of the course, students will be able to:***

1. List the guidelines for effective creation of multimedia content.
2. Understand different types of multimedia,
3. Apply multimedia guidelines for ethical multimedia content creation, analyze different multimedia formats,
4. Compare different multimedia compression storage formats and create ethical multimedia content

Course: Server Side Web Development

Course outcome: ***At the end of the course, students will be able to:***

1. Explain Web Technology and the difference between standalone application and the Web technology.
2. Develop web applications to solve various real life problems using the server side web scripting language – PHP, maintain security of the web based systems against the potential intruders.
3. Design interactive systems using the concept of AJAX.

Course: Embedded systems.

Course outcome: ***At the end of the course, students will be able to***:

1. Students will be able to understand how to model the real world in computers and
2. Design & test the solution before implementing.

Botany

PSO1: Acquire in-depth knowledge of Botany and its allied branches, develop skills to identify and classify plants belonging to different groups from microbes, Algae up to Angiosperms.

PSO2: Demonstrate various laboratory skills and acquire knowledge to handle instruments, equipment's, glass wares etc. in the field of Biotechnology, Genetics, Biochemistry, Molecular biology etc.

PSO3: Acquire time management skills. Develop awareness about environmental conservation and management strategies.

PSO4: Gain knowledge about various applicative botanical techniques in the field of Floriculture, Horticulture and use of traditional medicine which will enable them to be the entrepreneurs.

Course: BOC-101: Biodiversity I (Microbes, Algae, Fungi, and Bryophytes(
Course outcome: ***At the end of the course, students will be able to***:

1. Understand and distinguish between Microbes, Algae, Fungi and Bryophytes.
2. Study their structure, classification, life cycles and economical/ecological importance.
3. Apply the knowledge in the field of taxonomy, research, etc.
4. Develop awareness about environmental conservation.

Course: BOC-102: Biodiversity II)Vascular plants(
Course outcome***: At the end of the course, students will be able to:***

1. Understand, classify, and distinguish morphology, anatomy, reproduction of different categories/types of Vascular plants along with their economical/ecological importance.
2. Apply the gained knowledge in the field of taxonomy, research, etc.
3. Develop awareness about environmental conservation.

Course: BOC-103: Plant Anatomy and Embryology
Course outcome**: *At the end of the course, students will be able to:***

1. Develop an understanding about internal plant structure, reproductive structures through different tissues and embryological developmental stages of the plant.
2. Gain in depth knowledge of higher plants, their pollination, seed dispersal and importance of propagation.
3. Enhance students' laboratory skills.

Course: BOC-104: Plant Physiology
Course outcome: ***At the end of the course, students will be able to:***

1. Gain knowledge about significant biological processes in plants with their applications.
2. Get training in chemical preparations and handling of various laboratory instruments and equipment's.
3. Exhibit the skills to follow scientific protocols to achieve expected results.

Course: BOS 101: Floriculture

Course outcome: ***At the end of the course, students will be able to:***

1. Define, compare, demonstrate and explain different concepts associated with floriculture.
2. Compare and contrast different commercial plants in floriculture.
3. Gain thorough knowledge of different garden techniques, garden implements and their operations.
4. Apply the knowledge of floriculture to be entrepreneurs.

Course: BOS 102: Herbal technology.

Course outcome: ***At the end of the course, students will be able to:***

1. Acquire knowledge on herbal technology.
2. Gain knowledge about the chemical constituents and medicinal uses of herbs.
3. Develop an understanding about the traditional systems of medicines and be able to implement them in their daily life situations.
4. Learn the general techniques of collection and processing of crude drugs.
5. Develop awareness about environmental conservation.

Course: BGE-1 Environmental biotechnology.

Course outcome: ***At the end of the course, students will be able to:***

1. Develop an understanding about environment and its concern as a whole.
2. Acquire knowledge about methods and strategies of protecting our environment.
3. Develop awareness about environmental conservation.

Course: BGE-2 Coastal and Mangrove ecology.

Course outcome: ***At the end of the course, students will be able to:***

1. Relate Mangrove ecology to coastal ecology.
2. Explain biology, flora and fauna, reproduction and seed dispersal mechanism in mangrove ecosystem.
3. Understand the ecological role of mangroves.
4. Explain the threat factors affecting mangrove ecosystem and their conservation.

Biotechnology

PSO1: Students will gain the basic knowledge of biology to apply it with advanced technologies which are been utilized in various companies related to biotechnology and other disciplines of life sciences.

PSO2: This course will be the ground for carrying forward modern research in the life science which will provide an opportunity to join different institutes and universities based on the research interest.

PSO3: Students will be able to develop skills oriented towards improving employability through value added courses organized by the department in addition to the curriculum.

PSO4: Students will be able to use scientific methods to solve various research problems.

Course: Biochemistry and Metabolism (**BIC101)**

Course outcome***: At the end of the course, students will be able to:***

1. Explain Urey-Miller's experiment, the structure, function and properties of monosaccharaides, disaccharides and polysaccharides.
2. Discuss the classification of amino-acids.
3. Elaborate on the forces that stabilize protein structure.
4. State the factors that affect the stability of an alpha-helix.
5. Differentiate between reducing and non-reducing sugar.
6. Describe the structures and properties of lipids and nucleic acid.
7. Apply the knowledge in biological functions such as to identify mutation involved in pathologies.
8. Explain the factors affecting enzyme catalyzed reaction.
9. Compare different models of enzyme specificity.
10. State the roles of different Cofactors and coenzyme.
11. Explain the significance of the regulation of various metabolic pathways.
12. Discuss various metabolic pathways of lifecycle and energy synthesis.
13. Describe the fates of pyruvate under anaerobic conditions.

Course: Chemistry I for Biotechnology, CBC-101 (Atomic Structure, Bonding, General Organic)

Sec-A (Inorganic chemistry)

Course outcome: ***At the end of the course, students will be able to***:

1. State the theories and principles pertaining to Atomic structure and matter.
2. Interpret quantum mechanics, solve it for atomic model.
3. Draw shapes of various orbitals and their radial distribution functions Find the radial and angular nodes.
4. Give an outline of quantum numbers and its significance.

5. Express the electronic configuration of the atoms.
6. Correlate the stability associated with half-filled and completely filled orbitals.
7. Explain the concept of exchange energy.
8. Name the anomalous electronic configurations.
9. List the general characteristics; assess the energy considerations of ionic bonding.
10. Define lattice energy, solvation energy and their importance in the context of stability and solubility of ionic compounds.
11. Express the Born-Landé equation for calculation of lattice energy, illustrate the Born-Haber cycle diagram and its applications,.
12. Summarize Fajan's rules, calculate the ionic character in covalent compounds, define polarizing power and polarizability bond moment, dipole moment and percentage ionic character.
13. Compare VB Approach with VSEPR, interpret the shapes of some inorganic molecules and ions.
14. Reproduce the Concept of resonance and resonating structures in various inorganic and organic compounds.
15. Explain the MO Approach, MO treatment of homo-nuclear diatomic and hetero-nuclear diatomic molecules and compare VB and MO approaches.

Course: Section –B (Organic Chemistry)

Course outcome***: At the end of the course, students will be able to:***

1. Design the most probable mechanism for a particular reaction by implementing the knowledge of curved arrows.
2. Identify the comparative strength of organic acids and bases.
3. Draw the Newmann's configuration and to solve the problems on R and S configuration. Transform fischer to sawhorse representation.
4. Choose different methods for preparing alkanes, alkenes and alkynes.
5. Distinguish between the alkanes, alkenes and alkynes by giving examples.
6. Explain various reactions concerning alkanes, alkenes and alkynes.
7. Generate or develop their own reactions with the help of the different methods which are listed above.

Course: Animal Diversity I (ZBC101)

Course outcome: ***At the end of the course, students will be able to:***

1. Summarize the external as well as internal characters of Non-chordate animals.
2. Recognize and describe the ecological role of phylum, coelenterate, Platyhelminthes and Aschelminthes.
3. Draw relation between the Platyhelminthes and Aschelminthes & man.
4. Explain various terms such as Polymorphism, Metagenesis, etc.
5. Write a note on various types of stinging cells
6. Describe the coral reefs and their formation.
7. Classify Describe characters and ecological role of various phyla under study.
8. Inter relate the social interaction of different insects.

9. Enlist the general features of Earthworm and the process of vermicomposting.
10. Describe the coelom and metameric segmentation in annelids.
11. Explain the process of Metamorphosis in insects.
12. Write a note on different forms of larval forms of crustaceans.
13. Identify different diseases caused by insects and also their economic importance
14. Describe apiculture and sericulture.
15. Classify various phyla, describe their characteristics and sketch organism belonging to them.
16. Describe unique characters of phylum Mollusca, Echinodermata and Hemichordata.
17. Describe the larval forms of echinoderms.
18. Enlist and describe the affinities of *Balanoglossus.*

Course: Food Science and Nutrition (BIG101)

Course outcome: ***At the end of the course, students will be able to:***

1. Understand the Role of nutrition in health.
2. Know the different concepts of nutrition and also the significance and functions of food.
3. Apply the knowledge in consuming the proportion of food containing micro and macronutrients.
4. Know different vitamins and mineral in our diet
5. Understand the factors determining the energy requirement.
6. Plan the meal according to the requirements.
7. Imply the knowledge to maintain the balance diet.
8. Identify various functional food for maintaining the health

Course: English Communication (AECC 1)

Course outcome: ***At the end of the course, students will be able to***:

1. Understand and explain the process of communication and define the term communication and the different elements of communication such as sender, receiver, channel, feedback etc.
2. Distinguish between the different types and modes of communication such as formal and informal communication.
3. Write about the importance of feedback as well.
4. Learn the different ways in which we can communicate such as verbal, non-verbal that is spoken, written, use of body language etc.
5. Explain non-verbal communication.
6. Use communication in different contexts such as social, personal, business and different ways of communicating such as interpersonal, intrapersonal, upward, downward, communication etc .
7. Mention how to overcome barriers in communication.

8. Write and participate in a monologue, dialogue, group discussions etc.
9. Understand how to write and answer an interview.
10. Distinguish between effective communication and mis-communication. They will be able to explain the importance of effective communication.
11. Understand the importance of skills like reading, summarising and translation.
12. Write summaries of passages and attempt translation of passages from English to other languages such as Hindi, Marathi, and Konkani.
13. Attempt close reading of the given passage or poem.
14. Learn how to write reports, letters, attempt note-making, draft notices and minutes of a meeting etc.

Course: General Microbiology (BIC102)
Course outcome: ***At the end of the course, students will be able to:***

1. Classify microorganisms via Microbial taxonomy, understand molecular approaches, microbial phylogeny and current classification of bacteria.
2. Explain microbial diversity, morphology and cell structure of major groups of microorganisms
3. Characterize Prokaryotic and Eukaryotic cells.
4. Discuss the classification of microorganisms based on their primary source of carbon, energy and electrons.
5. Describe different methods of nutrient transportation in microorganisms and mechanisms of uptake of iron by microorganisms, different types of media used for cultivation, maintenance and isolation of microorganisms, different techniques used to get isolated microbial colonies (spread plate and pour plate techniques and streaking methods), Discuss the mechanisms by which different types of extremophiles adapt to certain conditions.
6. Compare and contrast different methods used for the preservation of microbial cultures.
7. Draw the Microbial growth curve and describe the features of each part of the same
8. Mention the features and application of synchronous, batch and continuous culture
9. Define the terms generation time, extremophiles, acidophiles, alkaliphiles, halophiles, thermophiles and psychrophiles.
10. Explain DNA transformation, bacterial sporulation, Transduction and Conjugation.
11. Describe or explain various metabolic pathways, amphi-catabolic and biosynthetic pathways taking place in microorganisms, bacterial pollutants of water, coliforms and non coliforms.
12. Explain the various methods used for control of microorganisms, the important microorganism in food microbiology: moulds, yeasts, bacteria
13. Mention the components of sewage and its disposal.
14. Comprehend major food born infections and intoxications.
15. List and explain preservation techniques and different types of fermented foods.

Course: Chemistry II for Biotechnology (CBC-102) (Sec-A Physical Chemistry)
Course outcome: ***At the end of the course, students will be able to:***

1. Define the terms involved in Chapters
2. Draw the graph for chemical equilibrium
3. State the laws of thermodynamics.
4. Classify Buffers.
5. Derive and use the equations to solve the numerical, calculate various parameters pertaining to the chemical equilibrium chapter.
6. Calculate the bond energies.
7. Interpret the relationship between equilibrium constants at constant temperature, pressure and mole fraction.

Course: Section – B (Organic Chemistry)

Course outcome: ***At the end of the course, students will be able to:***

1. Define and explain the terms involved giving examples.
2. Describe the preparation of various compounds involved.
3. Predict and compare the mechanism of reactions involved.
4. Propose the mechanism of similar reactions.
5. Predict the products, intermediates, reactants and reaction conditions for a given chemical reaction.

Course: Animal Diversity II (ZBC102)

Course outcome: ***At the end of the course, students will be able to:***

1. Give the general characters of protochordates.
2. Enlist the general features of cyclostomata and classify it.
3. Describe the general features of pisces, write a note on migration of fishes, and classify giving examples.
4. Give general features of amphibians, classify them, and briefly explain its origin.
5. Write a note on parental care, neoteny and paedogenesis in amphibia.
6. Give the general characters and explain the origin of reptiles, aves and mammals.
7. Explain the fight adaptation in birds and write a note on flightless birds.
8. Explain briefly the modification of beak and feet in birds.
9. Write a note on dentition in mammals.
10. Describe the aquatic and flying mammals, the different types of gills, swim bladder in fishes.
11. Explain about the epidermal and dermal derivatives, the migration in birds.
12. Write a note on lungs and air ducts.
13. Explain the anatomy of eye and ear.
14. Describe the circulatory system anatomy of heart and aortic arches, the urino genital system, kidney and nephron.
15. Explain the autonomic nervous system in mammals.

Course: Entrepreneurship Development (BIG102)

Course outcome: ***At the end of the course, students will be able to:***

1. Define and explain the terms and concepts involved giving examples.
2. Describe the meaning of the entrepreneur and also delineate the evolution and development of the concept of the term entrepreneurship.
3. Delineate the entrepreneurial decision process while establishing an enterprise.
4. Identify, classify and discuss the sources of finance and its importance to enterprises.
5. Appreciate the importance of marketing management in modern business organisations and elaborate the various elements of marketing mix. Also analyse and understand the importance of research and survey needed to know the competitive situation in the market.
6. Identify the importance of international business and to take an accurate decision with regards to selection of product and market for his sales. It also important to know the finance rise for exports and institutional support to it.

Course: Environmental Science (AECC 2)

Course outcome: ***At the end of the course, students will be able to***:

1. Define the terms involved in Environmental studies and also the scopes and importance of environmental studies.
2. Make awareness of current environmental status.
3. Differentiate the types of Renewable and Non-Renewable resources.
4. Understand the equitable use of resources for suitable lifestyle.
5. Know the different concepts of an ecosystem such as ecological succession and food webs
6. Draw the ecological pyramids.
7. Understand the threats of biodiversity and its in-situ and ex-situ conservation.
8. To identify the local pollution sites.

Course: Biochemistry (Paper –V)

Course outcome: ***At the end of the semester, students will be able to:***

1. Explain Urey-Miller's experiment
2. Discuss unique properties of water
3. Describe different types of molecular interactions
4. Explain the structure, function and properties of monosaccharaides, disaccharides and polysaccharides
5. Define and discuss the Classification of various biomolecules and their biological significance.
6. Draw the Structure of Amino acids and enlist their general properties
7. Explain the Structural levels of protein, the factors affecting enzyme catalyzed reaction.
8. Discuss the significance of Ramachandran Plot.
9. Describe the structure of DNA, RNA &their Types of DNA, the structures and properties of lipids.
10. Enlist the symptoms of different types of Vitamin deficiencies.
11. Enumerate the biological functions of various Co-enzymes.

12. Differentiate between reducing and non-reducing sugar.
13. Compare various models of enzyme specificity.
14. Describe various metabolic pathways of life cycle and explain the significance of their regulation.

Course: Biostatistics and Bioinformatics

Course outcome: ***At the end of the semester, students will be able to:***

1. Explain the types of biological data, apply types of sampling in biological studies.
2. Plot histogram, frequency curve, frequency polygon, ogive curves
3. Read and interpret histogram, frequency curve, frequency polygon, ogive curves
4. Solve problems to find the Mean, Median, Mode, Range, Standard deviation of the given data.
5. Calculate Permutations and Combinations, Probability of possible outcomes in a trial, Binominal distribution and Poisson distribution of a given data.
6. Frame a null hypothesis.
7. Calculate the degrees of freedom and level of significance of the proposed hypothesis.
8. Estimate the variation among and between groups of data.
9. Explain positive and negative Correlation.
10. Calculate the degree of correlation of the given data
11. Derive the regression equation for the given data.
12. Measure differences in observed and expected frequencies in the given data.
13. Define a biological database and explain the different types of data
14. Describe the different types of biological databases- literature, RNA, protein and structure databases.
15. Explain the working and salient features of BLAST and FASTA

Course: Essential Mathematics for Biologists

Course outcome: ***At the end of the course, students will be able to***:

1. Define sets and perform various operations.
2. Find the solutions for problems using the venn diagram
3. Calculate the solutions for linear and quadratic equations
4. Solve the matrices and evaluate the determinant, finding the solutions of the precautions using Cramer's rule
5. Find the sum of n terms in A.P and G,P
6. Expand the binomial theorem
7. Write the equation of straight line and circle
8. Differentiate and integrate the data provided.
9. Find the solution for the equations using linear programming

Course: Immunology

Course outcome: ***At the end of the semester, students will be able to:***

1. Define Plasma and Serum, Affinity, Avidity and cross-reactivity.
2. Describe innate immunity, acquired immunity, active immunization and passive immunization
3. Elaborate on different types of vaccines
4. Enlist different types of cells (neutrophils, basophils, eosinophils, mast cells, monocytes and macrophages) of the immune system and Compare their properties and roles in the immune system
5. Discuss the biological functions of antibodies
6. Illustrate the structure of antibody
7. Define and give examples Antigen, Hapten and Adjuvant , monoclonal and polyclonal antibodies
8. Differentiate between primary and secondary immune response.
9. Describe Coombs test, Immuno fluorescence, RIA and ELISAand the immune response against bacterial and viral infections, the steps involved in the process of Hypersensitivity.
10. Explain the effects adjuvants the immune response and the steps involved in maturation and activation of B cells and T cells
11. Differentiate between plasma cells and memory cells
12. Elaborate on Humoral immunity
13. To differentiate between antigen dependent T cells and antigen independent T cells, monoclonal and polyclonal antibodies
14. Discuss the characteristic features of different pathways for the activation of complement system and the structure of Human Immunodeficiency Virus with the help of a diagram.
15. Enlist the types of immune cells and chemicals involved in different types of Hypersensitivity

Course: Genetics and Molecular Biology

Course outcome: ***At the end of the course, students will be able to:***

1. Explain the process and role of various proteins involved in DNA replication, transcription, translation and DNA repair.
2. Explain various processes of recombination in prokaryotes
3. Define various terms involved in Genetics and Molecular Biology
4. Differentiate between various concepts such as incomplete and co-dominance, test cross and Back cross
5. State Mendel's laws of inheritance, characteristics of genetic code
6. Justify various statements and concepts from the syllabus
7. Describe the structure of chromosomes with proper diagrams

Course: Plant Biotechnology

Course outcome: ***At the end of the semester, students will be able to:***

1. Explain the concept of Plant Tissue culture and also outline the research findings in the field.

2. Design the PTC laboratory and choose the appropriate method of sterilization to be used for different equipments.
3. Formulate and prepare different types of PTC media.
4. Select the explants and choose the appropriate surface sterilizing agent.
5. Give examples for the ideal conditions of incubation and regeneration of cultures and give details of the structure and environmental conditions of the green house.
6. Summarize the concept of totipotency, somaclonalvariation,somatic hybridization classify the meristem based on their position and origin and to distinguish the callus tissue on the basis of colour, texture, microscopic examination.
7. Describe organogenesis and somatic embryogenesis, the various factors affecting it and its importance.
8. Explain the steps involved in the preparation of artificial seeds and its advantages
9. Explain the principle and importance of the root, shoot tip, anther and embryo culture.
10. Generalize the concept of cell suspension culture, the protocol and the different methods used for establishment of batch and continuous culture.
11. Identify the best method for protoplast isolation, the different enzymes used to isolate the protoplast, evaluate protoplast viability, explain the different methods for protoplast fusion, hybrid selection and culturing methods.
12. Explain the three stages of micropropagation, how tissue culture can be used in making gene banks and its importance in forestry.
13. Classify the secondary metabolites produced in plants and compare the different methods of culture used for secondary metabolite production.
14. Draw the structure of Ti plasmid and the virulence region and also explain the process of gene transfer and further elaborate on the methods used for the selection of transformants.
15. Draw the structure of the Cointegrate and binary vector and discuss the direct gene transfer methods like Microinjection, Particle gun method, Electroporation and Chemical methods.
16. Outline the application of transgenic plants

Course: Industrial Biotechnology

Course outcome: ***At the end of the course, students will be able to:***

1. Explain the stages of a bacterial growth curve.
2. Classify organisms by cell structure.
3. List and explain the working and use of fermentation equipment.
4. Illustrate the design of the commonly used bioreactors
5. State the principle, working, key features and applications of screening technique of microorganisms.
6. List and describe the various methods of preservation of microbes.
7. Distinguish between stock and working cultures and their significance.
8. Describe batch, fed batch, continuous and solid state fermentations
9. To list the various fermentation media, their components of, sources of carbon, nitrogen and vitamins and explain their significance.

10. List and explain the various methods and tests used to detect fermentation products, their principles and significance
11. Explain the principle and working of LAL assay.
12. State the significance Of ISO certification.
13. List good lab practices and their significance.
14. Explain the types and working of various types of downstream processes and significance.
15. Describe the production of Industrial Fermentation of Wine, Alcohol, Streptomycin and Penicillin.

Course: Techniques in Biotechnology

Course outcome: ***At the end of the course, students will be able to:***

1. State the types of radiations encountered in a biological lab and the precautions to be taken while dealing with radioactivity, the ways to deal with spillage and disposal of bio-hazardous wastes and the potential physical hazards in lab.
2. State the principle of Centrifugation and explain the factors that affect the process of centrifugation
3. Describe preparative and analytical centrifuges and their applications
4. Differentiate between Rate Zonal and Isopycnic centrifugation, between Native and SDS-PAGE.
5. State the principle of separation by different types of chromatography techniques**.**
6. Explain the instrumentation and working of GLC and HPLC
7. Explain separation of nucleic acids using agarose gel electrophoresis and separation of proteins by SDS-PAGE, Native-PAGE and Isoelectric focussing
8. Explain the role of SDS, TEMED, APS and Mercaptoethanol in electrophoresis, components of DNA and SDS-PAGE loading dye.
9. State the principle applications of PAGE, agarose gel electrophoresis, Isoelectric focusing and 2D-PAGE, FISH, Northern blotting, Southern Blotting and Western Blotting.
10. Discuss the methods employed to obtain DNA probes and the principle of different types of ELISA, RIA and other immunoassay based techniques.
11. Mention the method of labelling non-radioactive probes and radioactive probes.
12. Illustrate the technique of Western Blotting, Southern Blotting and Northern Blotting.
13. Outline the general procedure for RIA.
14. Explain the principle working and applications of RIA, ELISA, and other immunoassay based techniques, RAPD, RFLP, DNA fingerprinting, microarray and different types of PCR techniques.
15. Describe principles and applications of different types of PCR techniques.

Course: Concepts in Genetic Engineering

Course outcome: ***At the end of the course, students will be able to:***

1. Outline the Basic steps of Gene cloning

2. State the properties and applications of endonucleases, DNA ligases, Reverse transcriptases, Polynucleotide kinases, alkaline phosphatases and Nucleotidyltransferases.
3. Classify restriction enzymes based on recognition sequences and nature of cuts.
4. Differentiate between *E.coli* and T4 ligase
5. List the properties of ideal Vectors
6. Discuss the structure and properties of PBR322 Vectors, pUC18, Lambda gt10, M13, Mp8/9 and the Structure and uses of cosmids, phagemids ,YAC and YEP vectors, the advantages of cosmids over plasmids as cloning vectors
7. Describe Bacteriophages and M13 as cloning vectors, the use of linkers and adapters in gene cloning, techniques of electroporation, liposome mediated DNA transfer and $CaCl_2$ method, in vitro packaging of DNA of lambda phage.
8. State the applications of electroporation, liposome mediated DNA transfer and $CaCl_2$ method and principle, requirements and procedure for plasmid isolation by boiling method and alkaline lysis method
9. State the properties of agarose and explain the working and applications of Agarose gel electrophoresis, the use of Ethidium Bromide and Track dye in agarose gel electrophoresis.
10. Explain the principle behind analysis of DNA yield and purity using spectrophotometry
11. Describe and illustrate the construction of genomic and cDNA libraries.
12. Elucidate different methods used for screening libraries
13. Compare the Maxam Gilbert's method and Sanger's method for DNA sequencing
14. Discuss the advantages of automatic DNA sequence over Maxam Gilbert's method and Sanger's method for DNA sequencing
15. Highlight features of different levels of physical containment and Biological containment

Course: Animal Cell Culture
Course outcome: ***At the end of the course, students will be able to:***

1. List major historical contributors and their contributions.
2. List and give significance of washing room, media prep, sterilization room, inoculation and culture room, equipment, culture vessels for cell culture.
3. Describe basic techniques of cell culture, cell lines and maintenance, types of culture, transformed and normal cells, and cell growth (cell cycle, synchronization, apoptosis).
4. Explain the effect of Physico-chemical properties of culture media on growth of cells.
5. Differentiate between Natural media and Complex natural media, Artificial media and list their advantages & disadvantages, Primary and Established cell line cultures and their characteristics & methods of maintenance.
6. Describe Serum containing media, Serum- free media, Chemically defined media, Protein- free media, Basal salt solution(BSS), Other constituents of basal media, Vitamins, Amino acids, Trace elements, Inorganic ions and their use.

7. Explain the role of growth factors-promoting proliferation of animal cells and Special secondary metabolites / products, Serum as complex supplement, Influence of culture condition & media on protein expression.
8. List and explain types of culture. organ culture, whole embryo culture, histotypic culture, explants cultures,
9. Describe characteristics of normal and transformed cells, types of large scale culture of cell lines. monolayer culture, suspension culture, immobilized culture.
10. Know how to maintain stock cultures, Antibiotic free stock cultures, properties of transformed cells.
11. Explain physical methods of cell separation, separation based on cell size, cell density, cell surface charge, cell affinity, Separation by cytoflurometry and the concept of Cytogenetics, Karyotyping, Isoenzymes, immunological tests to study direct method and indirect method of cell measurements.
12. Illustrate the Eukaryotic cell cycle
13. Describe methods of Cell Synchronization. Gi, Gj/S, selective detachment synchronization, Phases of cell growth, population doubling level in cultured cells.
14. Explain Apoptosis in cultured cells and reasons for cell suicide, concept of tissue engineering. Artificial skin, artificial cartilage, Stem cell culture, cell culture based vaccine.
15. List valuable products available from cell cultures.

Course: Environmental Biotechnology

Course outcome: ***At the end of the course, students will be able to:***

1. State applications of various techniques studied for pollution control.
2. Define various terms involved in environmental Biotechnology
3. Explain various bioremediation techniques taught in the syllabus.
4. Justify various statements and concepts from the syllabus
5. Describe various water pollution, air pollution and soil pollution control measures.
6. Describe about the production of various bio-products

Course: Food biotechnology

Course outcome: ***At the end of the course, students will be able to:***

1. Explain the role of various microorganisms in food.
2. Describe the causative agent symptoms, diagnosis and treatment for various food borne Infections and diseases.
3. Discuss the use of various approaches to identify food spoilage organisms.
4. Explain the various food preservation methods.
5. Outline the HACCP system for food protection

Geology

PSO1: Understand physical nature and chemical composition of the Earth's interior; Identify& classify common rock forming minerals, rocks in hand specimen and under microscope; classify crystals based on symmetry.

PSO2: Understand stratigraphic and structural relations and deformational history with respect to plate tectonic theory and establish rock sequence and geological processes; understand the concept of geological time and space.

PSO3: Describe surface geological processes and the resulting landforms.

PSO4: Collect basic geological data in field; collect mineral, rock and fossil samples in field; Construct geological maps and cross sections; interpret geological maps, topographical maps, satellite imageries and aerial photographs; correlate geological units.

Course: Fundamentals of Mineral Science (GEC101)
Course outcome: ***At the end of the course, students will be able to:***

1. Students will be able to identify common rock-forming minerals in hand specimen based on their physical properties
2. Students will be able to find the symmetry in crystals and classify crystals based on symmetry elements
3. Students will be able to plot crystal faces on stereographic projection.

Course: Economic Geology (GEC103)
Course outcome: ***At the end of the course, students will be able to:***

1. Categorise and classify various economic ore minerals into their respective categories
2. Compare and contrast between ore minerals found locally to those found on regional scale.
3. Evaluate different processes of ore enrichment
4. Calculate ore reserves
5. To interpret the possible process of formation of ore from mineral examples.

Course: Introduction to Petrology (GEC104)
Course outcome: ***At the end of the course, students will be able to:***

1. Distinguish and discriminate all three rock types based on their respective properties
2. Categorize and identify the rocks in hand specimen
3. Compare and contrast between various igneous, sedimentary and metamorphic rocks
4. Apply knowledge in their field identification
5. Establish a relationship/lineage of different rock types.

Course: Earth's dynamics and Structural Geology (GEC107)
Course outcome: ***At the end of the semester, students will be able to:***

1. Explain the internal structure of the Earth and its gravity and magnetic.
2. Recognise the various structures exhibited by rocks.
3. Relate the rock structures to the forces involved in their formation.
4. Infer the nature of the rocks from geological maps.
5. Measure the attitude of the beds.
6. Create topographic maps.

Course: Crystallography and Optical Mineralogy (GEC108)
Course outcome: ***At the end of the course, students will be able to:***

1. Explain to a peer the working of a petrological microscope and differentiate and distinguish from biological microscopes
2. Identify the optical properties and use them in subdividing minerals
3. Distinguish and differentiate between different silicate group minerals
4. Compare the working of various binary systems and their applications to magmatic textures and processes
5. Derive 32 classes of symmetry by Herman Maugin and Gadolin symbols
6. Solve problems on axial rations, drawing of crystal models using geometrical techniques and stereographic projection of crystals.

Course: Sedimentary Petrology (GEC109)
Course outcome: ***At the end of the course, students will be able to:***

1. Categorise unknown rocks into the class of sedimentary rocks
2. Compare the characteristics of sedimentary rocks from different regions
3. Interpret the environments of deposition from the study of nature of sediments and their depositional structures.
4. Determine the order of superposition of rocks
5. Assess the grain size and grain size parameters.

Course: Metamorphic Petrology (GEC 112)
Course outcome: ***At the end of the course, students will be able to:***

1. Distinguish metamorphic rocks from other types of rocks
2. Categorize and relate the metamorphic mineral assemblages according to their modes of formation
3. Describe and discern the textures and structures exhibited by metamorphic rocks
4. Interpret tectonic settings based on the type of metamorphic rock.

Course: Physical Geology.
Course outcome: ***At the end of the course, students will be able to:***

1. To explain the results of the action of wind, water and glaciers on the Earth.
2. To compare the various geomorphological features of the Earth and justify their natural occurrence.

3. To evaluate the landforms in field.

Course: Minerals and Rocks.
Course outcome: ***At the end of the course, students will be able to:***

1. To explain the difference between different minerals and rocks to their peers.
2. To identify rocks found in their locality.
3. To summarise the divisions of the interior of the Earth.
4. To outline the theory of plate tectonics.
5. To assess the natural Earth with a renewed perspective.

Course: Basics of remote sensing.
Course outcome: ***At the end of the course, students will be able to:***

1. Know the basic principles of remote sensing.
2. Classify and categorise satellites launched by various countries.
3. Explain utility of different orbits for various types of satellites to their peer.
4. Interpret information from satellite imagery with emphasis on geological information.

Course: Water quality assessment.
Course outcome: ***At the end of the course, students will be able to:***

1. Students will be able to identify point and non-point sources of pollution
2. Students will be able to carry out water sampling and test important water quality parameters in field and in laboratory
3. Students will be able to represent water quality data graphically
4. Students will be able to carry out risk assessment in relation to water quality and suggest remedial measures.

Course: Crystallography, Mineralogy, Physical Geology.
Course outcome: ***At the end of the course, students will be able to:***

1. They will be able to explain to peer about the difference in a mineral and a crystal.
2. Differentiate between different types of mineral groups
3. To explain the results of the action of wind, water and glaciers on the Earth.
4. To compare the various geomorphological features of the Earth and justify their natural occurrence.

Course: Earth's dynamics and Structural Geology.
Course outcome: ***At the end of the course, students will be able to:***

1. Explain the internal structure of the Earth and its gravity and magnetic.
2. Recognise the various structures exhibited by rocks.
3. Relate the rock structures to the forces involved in their formation.
4. Infer the nature of the rocks from geological maps.
5. Measure the attitude of the beds.

Course: Mineralogy.
Course outcome: ***At the end of the course, students will be able to:***

1. Explain to a peer the working of a petrological microscope and differentiate and distinguish from biological microscopes
2. Identify the optical properties and use them in subdividing minerals
3. Distinguish and differentiate between different silicate group minerals
4. Compare the working of various binary systems and their applications to magmatic textures and processes
5. Derive 32 classes of symmetry by Herman Maugin and Gadolin symbols
6. Solve problems on axial rations, drawing of crystal models using geometrical techniques and stereographic projection of crystals.

Course: Sedimentary Petrology.
Course outcome: ***At the end of the course, students will be able to:***

1. Categorise unknown rocks into the class of sedimentary rocks
2. Compare the characteristics of sedimentary rocks from different regions
3. Interpret the environments of deposition from the study of nature of sediments and their depositional structures.
4. Determine the order of superposition of rocks
5. Assess the grain size and grain size parameters.

Course: Structural Geology and Geo-tectonics.
Course outcome: ***At the end of the course, students will be able to:***

1. Students will be able to identify geological structures in field and collect structural data
2. Students will be able to generate strain ellipsoid and infer past stress fields
3. Students will be able to solve structural problems graphically and using stereo-net
4. Students will be able to construct geological cross section using geological map

Course: Remote sensing and Photogeology.
Course outcome: ***At the end of the course, students will be able to:***

1. Know the basic principles of remote sensing.
2. Classify and categorise satellites launched by various countries.
3. Explain utility of different orbits for various types of satellites to their peer.
4. Utilize instruments and interpret quantitative date from aerial photograph.
5. Solve photogrammetric problems.
6. Interpret geological information from aerial photographs.

Course: Igneous Petrology.
Course outcome: ***At the end of the course, students will be able to:***

1. Students will be able to identify common igneous rocks both in hand specimen and thin section
2. Students will be able to identify and describe igneous structures and textures, and infer the geological processes involved in their formation and classify them.
3. Students will be able to interpret phase diagrams of common igneous systems.

Course: Metamorphic Petrology.
Course outcome: ***At the end of the course, students will be able to:***

1. Distinguish metamorphic rocks from other types of rocks
2. Understand and relate the metamorphic mineral assemblages according to their modes of formation
3. Describe and discern the textures and structures exhibited by metamorphic rocks
4. Interpret tectonic settings based on the type of metamorphic rock.

Course: Indian Stratigraphy.
Course outcome: ***At the end of the course, students will be able to:***

1. Students will be able to understand the mode of formation of different rock formations of India and correlating it with other formations will help in deciphering the geological history.
2. Students will be able to apply these stratigraphic principles during field investigations.
3. Students will be able to propose further refinement if needed in the already established stratigraphy of India.

Course: Economic Geology.
Course outcome: ***At the end of the course, students will be able to:***

1. Categorise and classify various economic ore minerals into their respective categories
2. Compare and contrast between ore minerals found locally to those found on regional scale.
3. Evaluate different processes of ore enrichment
4. Calculate ore reserves
5. To interpret the possible process of formation of ore from mineral examples.

Chemistry

PSO1: Students will be able to acquire core knowledge in Chemistry in the key areas, develop written & oral communication skills in communicating chemistry-related topics.

PSO2: Design & conduct an experiment, demonstrate their understanding of the scientific methods & processes.

PSO3: Develop proficiency in acquiring data using a variety of instruments, analyze & interpret the data, learn applications of numerical techniques.

PSO4: Realize & develop an understanding of the impact of Chemistry & science on society.

Semester-I

Course: Inorganic Chemistry and Organic Chemistry (CHC-101).

Course outcome: ***At the end of the course, students will be able to***:

Section-A (Inorganic Chemistry)

1. Define the terms involved in Atomic structure, Chemical bonding and molecular structure.
2. State the laws, principles, hypothesis of Bohr's theory, quantum numbers, wave mechanical model of an atom, Ionic bonding, Fajan's Rule, LCAO model.
3. Draw the Radial plots, probability density curves, Radial probability distribution curves, structures of different orbitals, Born Haber cycle structures of molecules based on hybridization VSERP theory and molecular orbital diagram of homonuclear and heteronuclear diatomic molecules.
4. Generalize the Bohr's theory, sign of wave functions, formation of bonding and antibonding molecular orbital and its stability.
5. Explain Bohr's theory, wave theory for structures of an atom, and general characteristics of Ionic compounds, origin of dipole moment and dipole percentage.
6. Derive de-Broglie's equation, solve numerical, Schrodinger's equation to interpret probability density. They will also able to solve numericals on dipole moment, % ionic character and bond order.
7. Interpret the size and shape of orbital's based on Radial and angular part of wave function.
8. Distinguish between bonding and anti-bonding molecular orbital's, sigma bond and pi-bond.the orbital's based on screening power and illustrate electronic configurations for different elements and comment on their stability.
9. Compare and differentiate between VBT and MOT.

Section-B (Organic Chemistry-I)

1. Extrapolate the knowledge of curved arrow notation to understand and design a probable mechanism of a reaction.
2. Explain the concept of physical effects and electronic displacements; chirality and stereoisomers; aromaticity; nucleophile and electrophile.

3. Describe the structure of organic molecules using the concept of hybridisation.
4. Compare the strength of organic acids and bases with emphasis on factors affecting pK values.
5. Identify whether a given organic compound is aromatic or not.
6. Draw and name the stereo-isomers as well as the aliphatic hydrocarbons (up to 5 carbons)
7. Interconvert the Wedge formula, Newmann, Sawhorse and Fischer representations.
8. Illustrate, giving reactions the functional group transformations in aliphatic hydrocarbons.

Semester-II

Course: Physical Chemistry and Organic Chemistry (CHC-102)

Course outcome: ***At the end of the course, students will be able to:***

Section-A Physical Chemistry –II

1. Define the terms involved in Chapters chemical energetics, chemical equilibrium, and ionic equilibrium and state the laws used in thermodynamics, thermochemical equilibrium.
2. Describe Buffer solutions, factors affecting ionization.
3. Explain the terms involved giving examples of one and two component systems, interpret the graphs, classify the types of cells standard state, enthalpies of solution, integral and differential enthalpies of solution and dilution.
4. Derive and use the equations to solve the numerical, calculate various parameters, examine the phase diagrams , explain the Thermodynamics of ideal solutions and reversible cells, applications of e.m.f and conductance measurements, Thermodynamic derivation of the law of chemical Equilibrium.
5. Discuss third law of thermodynamic and calculation of absolute entropies.
6. Interpret the Phase diagram, electrochemical series, Nernst equation.

Section-B Organic Chemistry-II

1. To discuss the methods of preparation of benzene, alkyl and aryl halides, alcohols, ethers, phenols and carbonyl compounds.
2. To illustrate various reactions on benzene, alkyl and aryl halides, alcohols, ethers, phenols and carbonyl compounds.
3. To discuss the Nucleophilic Substitution (SN1, SN2 and SNi) reactions of alkyl halides.
4. To explain the reactivity and relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides and to explain oxidation reactions of alcohols.
5. To describe benzene mechanism and mechanism of Pinacol-Pinacolone rearrangement.
6. To identify and distinguish between electrophilic and nucleophilic substitution reactions.

Semester-III

Course: Physical and Inorganic Chemistry.

Course outcome: ***At the end of the course, students will be able to:***

Section-I (Physical Chemistry)

1. Define the terms involved.
2. Draw the Phase diagrams etc.
3. Explain the terms involved giving examples of one and two component systems interpret the graphs, concept of critical solution (consulate) temperature.
4. Derive Thermodynamics relations and use the equations to solve the numerical, calculate various parameters, and examine the phase diagrams, Nernst distribution law.
5. Apply the phase rule equation for one component systems and reduced phase rule equation for two component systems. Steam distillation for immiscible system.
6. Interpret the Phase diagram.

Section-II (Inorganic Chemistry)

1. Define characteristic properties of the d-Block elements.
2. Explain properties of the elements of the first transition series, their binary compounds and relative stability of their oxidation states.
3. Explain complexes of 3d elements illustrating, co-ordination number and geometry .
4. Explain Werner's co-ordination theory and its experimental verification.
5. Define effective atomic number concept and chelates.
6. Understand nomenclature of co-ordination compounds.

Course: Organic and Inorganic Chemistry.

Course outcome: ***At the end of the course, students will be able to:***

Section-I (Organic Chemistry)

1. Define and explain giving examples the terms involved, the laws, the rules and the principles in UV –Visible Spectroscopy and Infra Red (IR) absorption spectroscopy.
2. Explain various electronic transitions in UV –Visible Spectroscopy
3. Apply Woodward-Fieser rules for calculation of λmax for Conjugated dienes and enones.
4. Explain the various factors which affect the intensity and position of IR and UV bands.
5. Explain the use of Finger print region to establish the identity of unknown compound in Infra Red (IR) absorption spectroscopy.
6. Give applications of UV –Visible Spectroscopy and Infra Red (IR) absorption spectroscopy.
7. Interpret the IR and UV spectra of simple organic compounds.
8. Elucidate the structure of simple organic compound using UV and IR spectroscopy.

9. Classify and name monohydric alcohols, dihydric alcohols, ethers, aldehydes and ketones.
10. Draw the structures of alcohols, ethers, aldehydes and ketones.
11. Describe the methods of preparations of monohydric alcohols, dihydric alcohols, ethers, epoxides, aldehydes and ketones.
12. Explain hydrogen bonding and acidity of alcohols.
13. Give physical properties of ethers, aldehydes and ketones.
14. Describe the reactions of alcohols, ethers, epoxides, aldehydes and ketones mentioned in the syllabus including mechanism and application.

Section-II (Inorganic Chemistry)

1. Define the concepts of oxidation and reduction
2. Apply knowledge of electrochemical series for predicting redox reactions.
3. Apply the redox cycle to understand redox reactions of elements in water
4. Draw frost, latimer and Pourbaix diagrams and apply them for various reactions.
5. Define lanthanides and understand their position, occurrence compounds and the oxidation states exhibited by them.
6. Understand the effects of lanthanide contractions on the elements of the periodic table
7. Understand the technique of lanthanide separation.

Semester-IV

Course: Physical and Inorganic Chemistry.

Course outcome: ***At the end of the course, students will be able to:***

Section –I (Physical Chemistry)

1. Define the terms involved.
2. Explain the terms involved giving examples of different forms of solids, unit cells, crystal systems.
3. Derive and use the equations to solve the numerical, calculate various parameters, Bragg's equation.
4. Explain the concepts of stability of colloids.

Section-II (Inorganic Chemistry)

1. Explain general characteristic properties of the d-Block elements.
2. Compare second and third transition elements with first series with respect to Ionic radii, oxidation states, magnetic behaviour, spectral properties and stereochemistry.
3. Explain isomerism in co-ordination compounds.
4. Define valence bond theory of transition metal complexes.

Course: Organic and Inorganic Chemistry.

Course outcome: At the end of the course, students will be able to:

Section –I (Organic Chemistry)

1. Write nomenclature of various structures and draw structures of various organic compounds.

2. Explain structure and bonding in organic compounds mentioned in the syllabus.
3. Compare acidic characters, physical properties and acid strength of alcohols and phenols.
4. Explain various mechanisms and preparation methods and synthesis mentioned in the syllabus of various organic compounds.
5. Explain properties and preparation of picric acid.
6. Explain structural features affecting basicity of amines.
7. Explain Stereochemistry of amines and separation of mixtures of primary, secondary and tertiary amines.
8. Study Dicarboxylic acids, their methods of preparations and effect of heat and dehydrating agents.

Section-II (Inorganic Chemistry)

1. Define actinides and understand their position in the periodic table.
2. Separate the individual actinides like Np,Pu, Am and U from their ores .
3. Define ionic solids and know the properties of ionic solids.
4. Draw the various types of close packing of spheres diagrams and calculate ionic radii using limiting radius ratios.
5. Draw the shapes of ionic solids like sodium chloride and cesium chloride
6. Derive the values of lattice energies of various ionic crystals.
7. Understand defects in stoichiometric and non-stoichiometric solids and apply this knowledge for finding out defects in various ionic solids.

Semester-V

Course: Inorganic Chemistry

Course outcome: ***At the end of the course, students will be able to:***

Section –I

1. Define the terms Crystal field splitting, Crystal field splitting energy,Crystal field stabilisation energy.
2. They will be able to state the laws involved in the distribution of electrons in the d orbital sets to draw the crystal field splitting diagram for octahedral, tetrahedral and square planar complexes.
3. They will be able to classify the ligands as strong field and weak field ligands
4. To distinguish between high spin and low spin complexes.
5. To explain the crystal field theory for co-ordination compounds, splitting for octahedral, tetrahedral and square planar complexes.
6. Illustrate examples of strong field and weak field ligands, high spin and low spin complexes.
7. To explain the factors affecting splitting energy.
8. To explain the spectrochemical series.
9. To interpret the magnetic properties from the slitting diagram.
10. To discuss the merits and demerits of crystal field theory.
11. To discuss the demerits of valence bond theory.

12. To predict the stability of complexes based on crystal field stabilisation energy.
13. To calculate the crystal field stabilisation energies of octahedral, tetrahedral and square planar complexes.
14. To calculate the magnetic moments for different transition metal complexes having octahedral, tetrahedral and square planar geometry.
15. Classify the elements as essential and trace and know their uses in various biological processes.
16. Draw the simple diagrams to represent Myoglobin and Hemoglobin.
17. Understand the roles of myoglobin and hemoglobin in oxygen transfer and respiration.
18. Explain non-molecular solids and their preparation methods.
19. Explain formation of band gap and classification of materials as metals, insulators and semiconductors.

Section-II

1. Define the terms Organometallic compounds, mononuclear,polynuclear metal carbonyls.
2. State the Effective atomic number rule, 18 electron rule for metal carbonyls and organometallic compounds.
3. State the names of metal carboyls and organometallic as per the IUPAC system.
4. Draw the structures of Ni(CO)4, Fe(CO)5, Cr(CO)6, Mn2(CO)10,Fe2(CO)9 ,Fe3(CO)12 and ferrocene.
5. Classify the ligands based on hapticity,to explain the bonding in organometallic and metal carbonyls based on valence bond theory and crystal field theory.
6. Illustrate examples of mononuclear, polynuclear complexes and ligands with varying hapticity.
7. Understand the concept of structures Ni(CO)4, Fe(CO)5, Cr(CO)6, Mn2(CO)10,Fe2(CO)9 ,Fe3(CO)12 based on hybridisation .
8. Discuss the Effective atomic rule and 18 electron rule for organometallic compounds, to predict the stability of complexes based Effective atomic rule and 18 electron rule,to calculate the Effective atomic number and 18 electron rule for different complexes.
9. Prepare alkyls and aryls of Li ,Al ,Hg and Ti by various methods.
10. Know the physical and chemical properties of alkyls and aryls of Li ,Al ,Hg and Ti
11. Understand the use of model systems in studying macromolecular biological molecules.
12. Define the roles of zinc and copper metalloenzymes in biological systems.
13. Understand process of nitrogen fixation by biological process using metalloenzymes.
14. Explain general methods of preparations of organometallic compounds
15. Explain preparation method and structures of polynuclear metal carbonyl like Mn2(CO)10 , Fe2(CO)9 andFe3(CO)12
16. Define and differentiate different types of defects.

Course: Organic Chemistry

Course outcome***: At the end of the course, students will be able to:***

Section- I

1. To explain the theory of Proton Magnetic Resonance (^{1}H NMR), ^{13}C Magnetic Resonance spectroscopy and Mass Spectrometry.
2. To explain giving examples stereospecific and stereoselective reactions.
3. To distinguish between SN1, SN2, SNi , substitutions and E1, E2 and E1cb elimination reactions.
4. To illustrate giving mechanisms the various addition, substitution and elimination reactions.
5. To explain the structure elucidation and synthesis of Nicotine, Atropine and Papaverine.
6. To identify the hybridization of carbons and nature of functionalization using ^{13}CMR chemical shifts.
7. To solve problems pertaining to the structure elucidation of simple organic molecules using spectroscopic techniques.

Section-II

1. To define the various terms involved in heterocyclic chemistry.
2. To sketch molecular orbital pictures and explain aromatic characteristics of various five membered and six membered compounds.
3. To describe the mechanisms of nucleophilic substitution reactions in pyridine derivatives; electrophilic substitution reactions of condensed heterocyclic compounds and preparations and reactions of indole, quinoline and isoquinoline.
4. To explain importance, use and structural elucidation of certain vitamins and hormones.
5. To illustrate preparation and reactions of amino acids.
6. To describe the classical methods of peptide synthesis; solid-phase peptide synthesis.
7. To determine the structure of peptides using end group analysis and selective enzyme hydrolysis.

Course: Analytical Chemistry.

Course outcome: ***At the end of the course, students will be able to:***

Section-I

1. Define the terms involved in sampling techniques, data handling and solvent extraction, electrolytic methods, potentiometric titrations.
2. State the laws and principles involved in solvent extraction, electrolytic methods, potentiometric titrations.
3. Explain scope and importance of analytical chemistry, sampling of liquid,solid and gases, different types of tests related to data handling, the different types of extraction.
4. Differentiate between various electrolytic methods, state and explain limits and merits of the various methods.

5. Draw the amperometric titration curves, schematic diagram of instruments and explain its working.
6. Classify and explain different types of errors, sampling techniques and types of extraction.
7. Derive and use the equations of linear least squares and method of averages and solvent extraction to solve numerical.
8. Interpret steps involved in chemical analysis.
9. Explain the principle of potentiometric titrations, location of equivalence point and types of potentiometric titrations.

Section-II

1. Define the terms involved in sampling techniques, data handling and solvent extraction, electrolytic methods, potentiometric titrations.
2. State the laws and principles involved in solvent extraction, electrolytic methods, potentiometric titrations.
3. Explain scope and importance of analytical chemistry, sampling of liquid,solid and gases, different types of tests related to data handling, the different types of extraction.
4. Differentiate between various electrolytic methods, state and explain limits and merits of the various methods.
5. Draw the amperometric titration curves, schematic diagram of instruments and explain its working.
6. Classify and explain different types of errors, sampling techniques and types of extraction.
7. Derive and use the equations of linear least squares and method of averages and solvent extraction to solve numerical.
8. Interpret steps involved in chemical analysis.
9. Explain the principle of potentiometric titrations, location of equivalence point and types of potentiometric titrations.

Course: Physical Chemistry

Course outcome: ***At the end of the course, students will be able to:***

Section-I

1. Define the terms involved in Quantum chemistry, electrochemistry, molecular structure and nuclear chemistry.
2. State the laws, principles, hypothesis, and postulates of quantum mechanics, Quantum chemistry, electrochemistry, molecular structure and nuclear chemistry.
3. Draw the schematic diagrams, diagrams of instruments, wave functions, orbital diagrams and the graphs involved.
4. Describe the working of instruments.
5. Explain the terms involved giving examples, interpret the graphs, classify the types of cells, nuclear models, and distinguish between working of instruments and merits and demerits of various instruments, models, and methods.

6. Derive and use the equations to solve the numerical, calculate various parameters, examine the graphs, explain the wave functions, nuclear models, emf series.
7. Interpret the wavefuction, distinguish between s, p, d, f orbitals, and compare the various methods involved in measurement of dipole moment.

Section-II

1. Define the terms involved in Quantum chemistry, electrochemistry, molecular structure and nuclear chemistry.
2. State the laws, principles, hypothesis, and postulates of quantum mechanics, Quantum chemistry, electrochemistry, molecular structure and nuclear chemistry.
3. Draw the schematic diagrams, diagrams of instruments, wave functions, orbital diagrams and the graphs involved.
4. Describe the working of instruments.
5. Explain the terms involved giving examples, interpret the graphs, classify the types of cells, nuclear models, and distinguish between working of instruments and merits and demerits of various instruments, models, and methods.
6. Derive and use the equations to solve the numerical, calculate various parameters, examine the graphs, explain the wave functions, nuclear models, emf series.
7. Interpret the wavefuction, distinguish between s, p, d, f orbitals, and compare the various methods involved in measurement of dipole moment.

Semester-VI

Inorganic Chemistry

Course outcome: ***At the end of the course, students will be able to:***

Section –I

1. Know the types of electronic transitions like d-d , charge transfer and ligand-ligand.
2. Understand the selection rules to determine whether the different electronic transitions are allowed or not.

3. Apply the knowledge of allowed transitions to determine ligand field strength, color of complexes, Cis-trans isomerism and Geometry of complexes.
4. Define the terms fuel gases, calorific value.
5. State the composition of coal gas, producer gas, water gas.
6. Draw the schematic diagram for manufacture of coal gas, producer gas and water gas.
7. Discuss the different factors affecting the synthesis of ammonia by Haber’s method and Nitric acid by Ostwald’s method.
8. Explain air pollutants, their sources, control w.r.t. oxides of Nitrogen, Carbon and Sulphur
9. Explain formation of Photochemical smog.
10. Discuss the phenomenon of acid rain and greenhouse effect
11. Explain Symmetry elements: Centre of symmetry, Rotation axis, Mirror plane, rotation – reflection axis and Identity
12. Identify symmetry elements in Transdichloroethylene, H2O and BCl3.

Section-II

1. Define the terms magnetic moment, hysteresis, Curie temperature, Neel temperature.
2. State the formula of magnetic moment and magnetic susceptibility.
3. Draw the graphs of temperature v/s susceptibility..
4. Discuss the different types of magnetism.
5. Calculate the magnetic moments of different transition metal complexes.
6. Explain what are nanomaterials, their properties and applications
7. Explain zeolites, their structure and applications
8. Discuss superconductivity and different types of superconductors
9. Define and know the properties of inorganic polymers.
10. Understand the concept of glass transition temperature of inorganic polymers
11. Classify condensation, addition and coordination Polymers
12. Discuss preparation, structure & bonding and applications of silicones
13. Define stability constants of reactions in terms of thermodynamic and kinetic stability.
14. Know the various factors affecting the stability constants of complexes.
15. Know the types of substitution reaction mechanisms of octahedral complexes
16. Understand the trans effect and to apply it to square planar complexes.

Course: Organic Chemistry

Course outcome: ***At the end of the course, students will be able to:***

1. Define the terms involved.
2. Classify Carbohydrates and terpenes.
3. Illustrate general reactions and discuss configuration of Monosaccharides with reference to glucose.
4. Discuss inter conversion of glucose and determine ring size of Monosaccharides with reference to glucose.
5. Draw cyclic structure of D(+)- glucose.
6. Describe mechanism of mutarotation, formation of glycerides, ethers, esters and structure elucidation of sucrose.
7. Explain the general methods of structure elucidation of terpenes.
8. Describe the chemistry of α-terpineol, camphor, citral, α-pinene and zingiberene.
9. Describe the synthesis of α-terpineol, camphor, citral and its conversion to ionones.
10. Explain the acidity of α-hydrogens and alkylation of diethyl malonate, ethyl acetoacetate, 1,3-dithianes, enamines and acylation of enamines.
11. Explain the keto-enoltautomerism and synthesis of ethyl acetoacetate by Claisen condensation.
12. Define and explain the terms saponification value, iodine value and acid value of oils.
13. Explain the chemistry of following- Natural fats, edible and industrial oils of vegetable origin, common fatty acids, glycerides, soaps, synthetic detergents, alkyl and aryl sulphonates.
14. Explain the hydrogenation of unsaturated oils.

Course: Analytical Chemistry
Course outcome: ***At the end of the course, students will be able to:***

1. Define the terms involved in basic electronics and thermal methods, radiochemical methods, UV Visible Spectroscopy, Chromatographic methods, Fluorimetry.
2. State the principles in thermal methods of chemical analysis and basic electronics, UV Visible Spectroscopy and Fluorimetry**,** principles of isotope dilution method and neutron activation analysis.
3. Draw the schematic diagrams, diagrams of instruments, circuit diagrams and the graphs involved.
4. Describe the working of instruments, electronic components and circuits.
5. Explain the terms involved giving examples; interpret the graphsin UV Visible Spectroscopy, chromatographic methods and fluorimetry.
6. Classify and explain the different types of chromatographic technique.
7. Derive and use the equations of Beer Lamberts law, Gas chromatography to solve numericals.
8. Discuss applications of UV Visible Spectroscopy, chromatographic technique and fluorimetry.
9. Analyse different parameters of water,air and soil analysis.

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